

# OVERWINTER SURVIVAL OF RING-NECKED PHEASANTS IN UTAH

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**ABSTRACT.**— The influence of winter weather on the survival of Utah's ring-necked pheasants was evaluated using correlation analysis. This method used published Utah State Division of Wildlife Resources population data and a calculated winter warmth index. Results show four different patterns of survival occurring in the 14 counties analyzed.

Wagner and Stokes (1968) estimated overwinter survival of ring-necked pheasants (*Phasianus colchicus*) in Wisconsin. They correlated a fall population index with an overwinter survival index and with a spring population index. Their results suggested density independent winter survival for the statewide population. Perry (1946) proposed that severe winter weather in New York affected the vigor of pheasants but did not significantly increase overwinter mortality.

Edwards et al. (1964), Gates and Woehler (1968), and Gates (1971) suggest that harsh weather, particularly in late winter and early spring, may cause increased mortality of hens in the early summer during the brood-rearing season. Gates (1971) proposed that a decrease in body weight of hens caused by harsh winter weather delayed egg laying in spring and resulted in hens entering the breeding season in suboptimal physical condition. During the nesting and brood-rearing period, hens continue to lose weight; this results in reduced production of young and may lead to the death of the hen. Other studies have shown increased mortality due directly to winter storms, with rates reaching as high as 90 percent (Kimball et al. 1956). Evidence also indicates that predation rates increase with severity of winter weather (Dumke and Pils 1973). In this paper, population dynamics of ring-necked pheasants in Utah are evaluated using indices similar to those employed by Wagner and Stokes (1968) to determine the relationship of winter weather to survival.

## METHODS

Data used in this analysis were compiled from Utah Upland Game Annual Reports from 1967 through 1979 (Nish 1967–1976, Bunnell and Olsen 1977–1978, Bunnell and Leatham 1979) and from Climatological Data of Utah (Mitchell 1962–1979). Preliminary models were derived for Box Elder, Cache, Duchesne, Sevier, Uintah, and Utah Counties to select indices for use in the final analyses.

The fall population index used was birds harvested per hunter day afield. In 1973 the daily bag limit on pheasants in Utah was lowered from three to two cocks per day. However, the mean harvest rate did not show a substantial decrease in response to this change. It appeared that reducing the bag limit did not influence hunter success. No attempt was made to adjust the fall index to the change in bag limit.

The summer index used was computed by subtracting young/km from total birds/km yielding an index of adult pheasants/km. These summer population data are collected each August along established census routes. Summer population data were used because spring population data were not available in Utah. Also, by using summer data we can incorporate summer mortality due to winter weather as discussed previously.

A winter survival index was calculated by dividing the summer index by the fall index of the previous year. All population indices

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were multiplied by 100 to give whole numbers.

In the preliminary models, a winter severity index utilizing temperature and precipitation variables similar to Gates' (1971) procedure was attempted, but no significant relationships were apparent between the survival index and the winter severity index. Precipitation alone showed no significant relationship to pheasant survival. There was, however, a significant positive correlation between winter (December, January, and February) temperature and the survival index. Hence, we hypothesized that for the areas of Utah studied, there was not enough precipitation during the winter months to significantly affect the pheasant numbers. Winter precipitation varied from only trace amounts in Emery County, to a high three-month total of 27.3 cm (10.75 inches) in Box Elder County. As a result of preliminary findings, a winter warmth index was used in this analysis, calculated by summing the average temperatures for December, January, and February only.

The fall population index was correlated with the log of the summer population index for the following year. The winter warmth index was correlated with the log of the appropriate survival index. Log transformations of the dependent variables were used because they yielded slightly higher correlation coefficients than analyses using raw data.

Areas analyzed were selected from throughout Utah. Counties were selected based on the completeness of their population data. Weather stations within the selected counties were selected based on their proximity to major pheasant-hunting areas and on the completeness of their climatological data (Table 1). Where monthly weather data were missing for any station, missing values were filled with appropriate monthly averages from 1962 through 1979. For stations with missing data for an entire year, values were estimated using data from a neighboring station.

## RESULTS

The major pattern of population dynamics identified in this study showed a strong correlation between the fall and summer population

indices, with little or no influence of winter temperatures on survival (Table 2). This pattern was observed for Beaver, Box Elder, Juab, Salt Lake, Tooele, and Utah Counties. It implies that overwinter survival rates do not fluctuate radically from year to year, since the number of birds in the summer is influenced predominantly by the number of birds present the previous fall. Given the wide range of fall population numbers observed through the study period, the above-mentioned counties seem to exhibit survival rates that are independent of fall population size. Because overwinter survival does not seem to be influenced by population size or winter weather in these counties, factors influencing reproductive success are probably most crucial to these populations. Factors that have been shown to be influential to reproductive success include excessive hen mortality due to farming operations (Gates 1971), nest and hen predation (Dumke and Pils 1973), and variable springtime weather conditions (Besadny 1967, Stokes 1968).

Another pattern of survival was expressed in Millard and Sevier Counties. The fall and summer population indices were strongly correlated, as were the winter warmth and survival indices. This correlation implies density-independent overwinter survival as discussed for the counties previously mentioned, with winter temperatures also playing a part in population dynamics.

TABLE 1. A list of counties on which the analysis was run and weather stations used. All counties had 17 years of data except Beaver.

County	Weather station	Population data missing 1962-1979
Beaver	Beaver	1965
Box Elder	Brigham City	None
Cache	Logan	None
Duchesne	Roosevelt	None
Emery	Castle Dale	None
Juab	Nephi	None
Millard	Fillmore	None
Salt Lake	Salt Lake Airport	None
Sanpete	Moroni	None
Sevier	Richfield	None
Tooele	Tooele	None
Uintah	Vernal	None
Utah	Provo	None
Weber	Ogden	None

TABLE 2. Summary of the correlation analyses for each county. The table includes sample sizes used to determine fall and summer indices, correlation coefficients, and mean coefficients of determination ( $R^2$ ) for groups of counties showing similar responses.

County	Hunters reporting fall harvest 95% C.I.	Km of summer pheasant routes 95% C.I.	Fall vs. summer index r =	Mean R <sup>2</sup>	Winter warmth vs. survival index r =	Mean R <sup>2</sup>
Beaver	34 ± 5.6	153 ± 47.2	0.67°°		0.15	
Box Elder	587 ± 65.2	248 ± 21.4	0.73°°		0.36	
Juab	79 ± 9.9	58 ± 8.2	0.80°°		0.20	
Salt Lake	548 ± 48.2	286 ± 86.8	0.70°°		-0.39	
Tooele	117 ± 17.4	103 ± 13.3	0.47°		0.25	
Utah	827 ± 77.0	569 ± 67.7	0.66°°	0.46	-0.04	0.07
Millard	220 ± 21.5	401 ± 42.9	0.67°°		0.57°°	
Sevier	185 ± 21.0	289 ± 37.1	0.66°°	0.44	0.62°°	0.35
Cache	437 ± 41.2	231 ± 58.0	0.39		0.61°°	
Sanpete	214 ± 25.7	262 ± 60.7	0.35	0.14	0.41°	0.27
Duchesne	148 ± 16.1	567 ± 28.5	-0.11		0.30	
Emery	135 ± 13.9	271 ± 46.4	0.18		0.34	
Uintah	141 ± 11.4	260 ± 42.7	-0.03	0.02	0.15	0.08
Weber	496 ± 47.8	149 ± 17.6	0.03	0.00	-0.49°	0.24

° = P < 0.05  
°° = P < 0.01

Pheasants in the western plains have been shown to suffer direct storm-induced mortality during extremely harsh periods (Kimball et al. 1956, Lyon 1959). Pheasant losses in Millard and Sevier Counties may be a result of direct winter mortality, or mortality occurring during the nesting season due to winter weather, as suggested by Gates (1971). Analysis of winter mortality and vigor in these areas may help determine mechanisms of weather-induced mortality.

Significant correlations between the winter temperatures and the survival indices, with no statistically significant correlations between the fall and summer indices, were shown for Cache and Sanpete Counties. Winter temperature, although a significant factor to survival, accounted for only about 27 percent of the variability in the survival index. This fact, coupled with the lack of correlation between fall and summer indices, implies highly variable November to August survival rates for these counties, with winter temperatures playing a minor although important role.

Duchesne, Emery, and Uintah Counties showed no significant correlation in either of the correlation analyses. These results suggest

only that survival rates are highly variable and winter weather has very little influence on the pheasant populations. Any pheasant studies in these counties should look closely at the influences of population size, reproductive success, habitat, and food requirements on the ecology of these populations.

Weber County was unique in expressing a significant negative correlation between winter temperatures and the survival index with no relationship between fall and summer indices. In Weber County, survival rates seem to decrease when winter temperatures increase and are highly variable from year to year. These results are presented here with no attempt at interpretation.

Through a series of indices and their interactions, we have shown several patterns of overwintering population dynamics for pheasants in Utah. We are not suggesting that county boundaries delineate unique ecological situations. By using data from individual counties, we have been able to show that variation exists between different areas of the state. The methods outlined in this paper do not propose to give definitive solutions to particular population dynamics. They are intended to yield generalizations concerning

factors that may be influential on a particular population. These techniques can be used on any wildlife species for which there are population data as a preliminary analysis to provide guidance for major studies. Once crucial factors are identified, further research can be more precisely directed to determine specific factors that may be limiting survival.

#### ACKNOWLEDGMENTS

We thank S. D. Bunnell, J. T. Flinders, and K. T. Harper for their assistance during this project and also for critically reviewing the manuscript.

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